[Proc. Roy. Soc. Victoria, 31 (N.S.), Part II., 1919].

Art. X.—*New or Little-known Victorian Fossils in the National Museum.*

Part XXII.—Palaeozoic Worms; with evidence of Soft Parts.

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(With Plates XIII. and XIV.).

[Read 8th August, 1918].

Introduction.

This paper is largely concerned with the relationship of the genus *Trachyderma*, Phillips, previously discussed in this series,[1] as seen in the light of some more or less recent discoveries of remarkable, well-preserved gill-plumes (prostomial appendages) of these worms. It thus fairly establishes the claim of these fossil worms, formerly described by Phillips, Salter, Cowper Reed and the writer, to belong to the Chaetopoda and having affinities with the Cryptocephala, to which the sabellids and serpulids are referred by Dr. B. Benham.[2]

The fleshy appendages of the Victorian Silurian worms, as here understood, have generally been referred by collectors to "fucoids," and it was only by the discovery of better-preserved specimens, and their association with tubes of *Trachyderma*, that their true relationship was conclusively made out.

The latter part of this paper deals with the genus *Cornulites*, and the description of a new species in Victoria. So rare is this genus in Australia that only one other species appears to have been previously known, namely, *C. tasmanicus*, described by R. Etheridge, junr., from Heazelwood and Zeehan, Tasmania.

PHYLUM VERMES. Class CHAETOPODA (Bristle-worms).

Sub-class Polychaeta (Marine-worms).

Fam. Trachydermidae, Chapman.

Genus **Trachyderma**, Phillips, 1848.[3]

Notes on the Genus.

Phillips founded this generic type on the "external case or tube (analagous to the 'shell' of *Serpula* and *Spirorbis*). . . .

1 These Proceedings, vol. xxii. (N.S.), pt. ii., 1910, pp. 102-105.
2 Cambridge Nat. Hist., vol. ii., 1896. Polychaete Worms.
3 Mem. Geol. Surv. Gt. Brit., vol. ii., pt. i., 1848, p. 331.

The structure of the covering is, in the arrangement of the incremental lines and rings, more analogous to that of the Serpulidae than to what occurs on other groups of Annelida, or on the fistuliform Radiaria and Ascidiae. It may, in fact, be pretty exactly paralleled on large specimens of Serpulidae."

From figures and descriptions of the various species of the genus—as *T. coriacea*, Phillips,[1] *T. laevis*, McCoy,[2] *T. serrata*, Salter,[3] and *T. squamosa*, Phillips,[4] of Llandeilo to Upper Ludlow (Lower Ordovician to Upper Silurian) age—it is seen that a thick coriaceous tube with a more or less obtusely rounded extremity serve to separate it from Salter's genus *Scolecoderma*,[5] a species of which, S. *antiquissima*,[6] was formerly referred by Salter to *Trachyderma*, but which has a thin membranous tube and a tapering and pointed extremity.

With reference to the scope of *Scolecoderma* as a genus, we may note that there is room for it in its restricted sense, but from Mr. R. Etheridge senior's interpretation it would embrace the earlier described genus *Trachyderma*. Thus, in Salter's Palaeontology,[7] revised by R. Etheridge in 1881, we read :—

"*Scolecoderma*, *Salter*, 1866. Mr. Salter proposed this term for all such membranous tubes (often much compressed) of annelides, found in palaeozoic rocks, as are not clearly referable to the more calcareous, or at least semi-calcareous tubes of *Serpulites*. They are very common. In a few cases it is possible we may mistake impressions of sea-weed for these; but their position in the beds, often vertical or oblique to them, will determine that they do not belong to the algae; and the want of any branches or subdivision of the frond will also tend to determine them. Sometimes they are cylindrical, more often compressed, and we may distinguish this convenient but artificial genus, comprising probably many different genera of annelida from the common *Scolites* by its having clearly possessed a wall or tube which renders the cast easily separable from the matrix, whilst *Scolites* only represents the track of the burrow."

The two species of *Trachyderma* previously met with in Victoria

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1 Mem. Soc. Geol. Surv. Gt. Brit., vol ii., pt. i., 1848, p. 331, pl. iv., figs. 1, 2.

2 Brit. Pal. Fossils, 1852, p. 133, pl. *id.*, fig. 13.

3 Quart. Journ. Geol. Soc., vol. xx., 1864, p. 290, pl. xv., fig. 9.

4 Mem. Geol. Surv. Gt. Brit., vol. ii., pt. i., 1848, p. 332, pl. iv., fig. 3. Also *T.* cf. *squamosa*, Reed, Pal. Indica. (N.Ser.), vol. ii., No. 3, 1906, p. 129, pl. vii., fig. 17.

5 Mem. Surv. Geol. Gt. Brit., vol. iii., 1866, p. 292; 2nd ed., 1881, p. 484.

6 Salter, Cat Cambro-Silurian Fossils, 1873, p. 10.

7 Mem Geol. Surv. Gt. Brit., vol. iii. 1881, 2nd ed., p. 484.

have been described as *T. crassituba, Chapman*,[1] and *T.* cf. *squamosa*, Phillips.[2] The soft appendages now referred to apparently belong to the former species, though this can only be surmised in the majority of cases from the tubes associated with them.

TRACHYDERMA, sp. cf. CRASSITUBA, Chapm., *et alii specierum.*

General Observations.—In 1910 the writer described two specific forms of worm-tubes from both the Melbournian and Yeringian beds of Victoria. These were referred to the genus *Trachyderma* of Phillips, similar fossils having been recorded from the English Ludlow series and the Silurian of Burma.

These tubes are normally found in the condition of mud-casts, with a harder outer covering, probably originally chitinous or subchitinous, of the nature of an organic slime and mud fabric.

No remains of any soft parts of the worms of this generic type seem to have been previously recognised. Many examples, now referred to the cephalic (prostomial) appendages of these tube-building worms, have from time to time been found in the Silurian mudstone of South Yarra and Melbourne by Mr. F. P. Spry, but until lately these specimens baffled all attempts to establish their true nature. Within the last few months Mr. A. James, B.A., B.Sc., was so fortunate as to find, in a bed of this fine-textured blue mudstone, about four miles north-west of Keilor, some beautifully preserved examples of fossil remains similar to those previously referred to as occurring near Melbourne.

That these fossils have a direct relationship to *Trachyderma* is strongly supported by the fact that they are found associated with *Trachyderma* tubes at South Yarra and Keilor,[3] in which deposits they are the only fossils to be found. Moreover, the morphological structure of the impressions and carbonaceous stains, here referred to these gill-like cirri, and which are often surprisingly clear and sharp, resemble no other animal organism, not excepting pennatulids, cirripedes and other like structures. As regards a plant origin for these remains, the single or double series of serrae with a hollow flexuous canal, preclude them from any such reference.

Description of prostomial gill-plumes.—The axis of the plumes is a hollow tube, well seen in more than one example. It is bent

1 Proc. Roy. Soc. Victoria, vol. xxii. (N.S.), pt. ii., 1910, p. 103, pl. xxvii, figs. 1*a*, *b*, 2, 3, 4; pl. xxix., fig. 1.

2 Ibid., p. 104, pl. xxvii., fig. 5.

3 At Keilor the tubes yet discovered are related to *T. crassituba* in having a thick wall, but it is of a more slender form, and may, on finding further examples, prove to be new. The gill-plumes from the two localities also show slight differences.

in a series of graceful curves, sometimes in a double, sigmoidal or ear-shaped curve, or coiled closely in helicoid fashion. The branchlets are disposed along one face, the inner, except rarely where recurved, and vary in length, being short and stout at the base, to long, flexible and slender nearer the distal end. The outer surfaces of the branchlets are pectinate to filamentous, generally recurved at the tip towards the axis, but occasionally thrown forward. In the blue-grey shale of Keilor the impressions stand out clearly, being of much darker tint. The South Yarra specimens, in yellow shale, are contrasted by bleaching, being paler in tint, or as in the dark blue indurated shale from the Domain Road Sewer, of a carbonaceous shade against the pale grey matrix of the immediate surroundings.

Dimensions.—Length of a large specimen, from the Melbourne district, about 4 cm. Length of another example, from South Yarra, 17 mm.; length of branchlets, 3.5 mm. A specimen from Keilor, 20 mm. long; length of longest branchlet, 12 mm.; depth, 1.25 mm.; depth of thickest branchlet, 3 mm. Thickness of axis about 1 mm.

Evidence of eyes and dorsal appendices.—On one of the best preserved specimens, which has been sharply flexed, can be made out, when held at a low angle to reflected light, some depressions with a central bulb, and an offset of a fistulose shape just above, and partially enclosing it. The axis of the branchial process in this specimen is transversely striated.

Occurrence of prostomial gill-plumes of Trachyderma.

Melbournian. In buff mudstone, Swanston Street Sewer, near Collins Street (F. P. Spry coll.), hard blue mudstone, Domain Road Sewer, South Yarra (F. P. Spry coll.); blue mudstone, Hawthorn Road Main Drain (F. P. Spry coll.).

Probably Melbournian. Slaty-blue mudstone, four miles north-west of Keilor (A. James coll.). Also tubes of *Trachyderma* with fragments of prostomial impressions (one pectinated), from Silurian mudstone, probably on Warrandyte Anticline at Quarry near Scotchman's Creek, Mulgrave (R. A. Keble coll.).

General Observations on the soft and other parts of Worms found Fossil.—In the Text-book of Zoology, Parker and Haswell,[1] reference is made to the occurrence of Chaetopods in the fossil condition, as follows :—

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1 Vol. i., London, 1910, p. 448.

"Owing to the soft character of most of their parts, there are comparatively few actual remains of Chaetopods in the older geological formations, though there are many burrows and tracks which have been ascribed to members of that class. Tubes of tubicolous Polychaeta have, however, been found in formations dating from the Cambrian period onward." Since this was written Cambrian annelids have been described by C. D. Walcott from North America.[1] They belong to the Class Chaetognatha (Amiskwia, Walcott); the class Chaetopoda, sub-class Polychaeta (order *Miskoa*, Walcott); and to the class Gephyrea (Fams. *Ottoidae* and *Pikaidae*, Walcott). These annelids are preserved in their entire form and pressed flat upon the surface of the shale. They are conspicuous in having a shiny film which lies upon a lighter background of shale, and from them Dr. Walcott obtained many remarkable photographs by adjusting the light and carefully re-touching the actual structure seen in the fossil.

The prostomial gills of *Trachyderma* here described are also represented by a dark film, on a lighter grey-shale background, but the fossil remains do not exhibit a sheen, as in the Middle Cambrian examples from British Columbia, above mentioned.

From the Ordovician Shale of Cincinnati, Ohio, Dr. E. O. Ulrich described as far back as 1879[2] some filiform segmented worms, probaly polychaete in affinities, as *Protoscolex*. In the same paper Ulrich figures what is perhaps more interesting from the present standpoint, another form, *Eotrophonia setigera*,[3] which undoubtedly represents prostomial appendages of an annelid.

Those fossils which have been from time to time figured as *Nereites*, as for example, *N. cambrensis*, Murchison,[4] from the Llandeilo of South Wales, I hold to be true impressions of the soft parts of nereid worms, since the lateral serial lobes are exactly similar in form to the parapodia of certain nereid worms like *Phyllodoce*.[5] That they are not due to casual trails of crustaceans, tracks of molluscs, brown seaweeds or other adventitious agencies seems very evident from the sharpness of the impressions, although Nathorst[6]

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1 Smithsonian Misc. Coll., vol. lvii, No. 5, 1911. Middle Cambrian Annelids.

2 Journ. Cincinnati Soc. Nat. Hist., vol. i., 1879, pp. 87-91, pl. iv., figs. 1-4. (I am indebted to Dr. Ulrich for a typed copy of this scarce work, with photo-reproductions of the plate).

3 Ibid., plate iv., figs. 5, 5*a*.

4 Silurian System, pt. ii., 1839, p. 700, pl. xxvii. fig. 1. Siluria, 3rd ed., 1859, p. 220, fossils, p. 221, No. 42(3). Bailey, Char. Brit. Foss., 1865, pl. vi., fig. 6.

5 Cf. Cambridge Nat. Hist., vol. ii, 1896. Polychaet Worms. Benham, p. 314, fig. 165.

6 K. Svenska Vet. Akad. Handl., vol. xviii., No. 7, 1881. Also ibid., vol. xxi., No. 14, 1886.

has figured many illustrations of these latter in refutation of some fossils figured as "fucoids," with good reason.

Relationship of Trachyderma to modern forms.—One of the chief determinative characters of these fossil forms in their genetic relationship would probably be the morphology and arrangement of the prostomial gills. These, in the *Trachydermae* now described consist of fairly broad, unilateral, frondescent processes, having a sigmoidal curvature and a well-defined axis. Judging by the appearance of one finely preserved specimen in which the processes lie back to back, they were probably paired. The nearest types of Chaetopods of this character are grouped in the sub-order Sabelliformia.[1] In these forms the branchiae are all more or less distinctly plumed or furnished with secondary filaments, unlike those of the sub-order Terebelliformia, which have simple filose or arborescent processes. The structure of the gills in *Trachyderma* shows many close points of resemblance to *Dasychone*, as in the flattened axis, the secondary pinnules on the inner, concave side of the stem, and especially in the presence of numerous eye-spots and processes known as dorsal appendices.[2] These eyes have been detected on several specimens, so that it is not due to any misinterpretation of the surfaces of the matrix.

The *Sabellidae* form their tubes of mud or sand, or of both, and are usually found in low water as well as to some considerable depths. In the absence of further morphological characters it is advisable to place the Silurian fossil form in a new family, the *Trachydermidae*.

In comparing the recent worms my attention was first drawn to some of the worms of the sub-order Terebelliformia, which also make their tubes of mud or sand. In *Amphitrite johnstoni*, for example, "the gills consist of a curved stem from the convex side of which arise a number of branches, themselves dichotomously divided, the final branches being long."[3] The pectinate secondary filaments in *Trachyderma*, however, are normally on the concave side of the stem, but occasionally on the outer side when the axis is reflexed. The structure of the axis also agrees more closely with the sabellids, and the vestiges of eyes and dorsal appendices in the fossils are essentially like those of this group.

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1 See Camb. Nat. Hist., vol. ii., 1896. Polychaet Worms. Benham, p. 336.

2 Op. cit., p. 337, fig. 382*b*. Also cf. *Dasychone capensis*. Rep. Chall. Zool., vol. xii., 1885. Annelida Polychaeta, McIntosh, p. 506, pl. liv., fig. i.

3 Camb. Nat. Hist., tom. cit., pp. 328, 329 (fig. 176*a*).

Fam. SERPULIDAE.

Genus **Cornulites**, Schlotheim, 1820.

[*Note.*—This genus is variously regarded as a member of the Annelida or of the Pteropoda. Thus Benham[1] says:—"Many of the tubes referred to Polychaetes by the earlier palaeontologists have been transferred to other groups; thus *Cornulites* is now believed to be a Pteropod shell." In Eastman-Zittel,[2] Dr. G. J. Hinde defines *Cornulites* as "Thick-walled, trumpet-shaped tubes, *Serpula*-like at the lower end, and sometimes attaining a length of three or four inches. Exterior annulated and covered with very fine longitudinal striae. Some authors regard the tubes as Pteropod shells." The genus is there placed, under Chaetopoda, Order Tubicola. The present writer holds that the evidence for the annelid nature of these tubes is quite convincing, since the internal microscopic structure of the shell, as shown by G. R. Vine,[3] is identical in many points with some living tubicolar forms belonging to the family *Serpulidae*, and this is further strengthened by the frequent occurrence of attachment in the earlier stage to foreign bodies.]

Cornulites youngi, sp. nov. (Plate XIII., Fig 4; Plate XIV., Figs. 13, 14.)

Description.—Shell hollow, conical; sides widening moderately rapidly, and expanded at the apertural extremity. Base blunt, subrounded and impressed, as would be the case if attached to a small foreign body. Annulations consisting of a closely set series of well-marked rings projecting from the general surface of the tube, each ring having a sharp, finely tuberculated central ridge or ring, with two lateral ones, sharp and smooth. Longitudinal striae clearly visible, and under a lens, a series of finer, transverse striae between them, somewhat similar to that seen in Vine's *Cornulites scalariformis*.[4] The holotype is practically uncrushed, although in compressed shale, showing the shell was sufficiently thick to withstand the pressure of the sediment as it was thrown down.

Measurements.—Holotype. Length, 24 mm.; greatest width, at apex, 10 mm.; width at middle of shell, 6 mm.; width at 1 mm.

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1 Camb. Nat. Hist., vol. ii., 1896, p. 302.
2 Vol. i., 2nd ed., 1913, p. 139.
3 Quart. Journ. Geol. Soc., vol. xxxviii., 1882, pp. 379-381, pl. xv., figs. 1, 9, 10.
4 Ibid., pl. xv., fig. 1*a*.

from base of shell, 3 mm.; about 10 rings to 10 mm. counting from the basis of the shell; 22 rings in total length of shell.

Another, larger, example from the same locality, somewhat badly crushed, has a length of 55 mm. The annulations are about 3 mm. apart in the wider part of the shell. It is probably a senile example of the same species.

Observations.—This species of *Cornulites* is apparently the oldest recorded. The well-known *C. serpularius*, Schlotheim,[1] is a much larger form than ours, and has the distance between the annuli longer. *C. flexuosus*, J. Hall,[2] is closely related to *C. serpularius*, but having a flexuose opex. *C. scalariformis*, G. R. Vine,[3] from the Lower and Upper Wenlock Shales, differs from the Australian species also in having more widely spaced annuli, but the character of the rigid portion of the annulation is in keeping with ours in having a blunted crest, but without a central keel.

The Tasmanian species, *C. tasmanica*, R. Etheridge, junr.,[4] differs in its more quickly tapering shell and decided flexuous habit. The specimens occur as casts in a blue-grey or whitish mudstone from Heazlewood and Zeehan.

Age of the Victorian specimens.—The two examples of *C. youngi* were found in a dark blue slate associated with the remains of the following graptolites:—

Didymograptus caduceus, Salter; *Tetragraptus serra*, Brongn. sp.; *T. quadribrachiatus*, J. Hall sp.; and *Oncograptus* sp.

This assemblage of graptolites points to the lowest part of the Darriwillian stage (4th in the series), of the Lower Ordovician.

Occurrence.—In dark blue slate with cleavage at a low angle to bedding plane. Moorabool River, near Meredith, N.W. of Geelong. Two examples; presented by Mr. James Hay Young, after whom the species is named, in recognition of his valuable assistance in collecting new and rare fossil specimens.

Note on *Pteroconus mirus*, Hinde.[5]

The shell of this generic type recalls *Cornulites*, the chief difference being the "shelly flap or fin-like extensions disposed at regular intervals from the basal point to the summit aperture." There is also a central rod-like structure often present, which, as

1 Schlotheim. Petrefactenkunde, 1820, pl. xxix., fig. 7. Murchison's Silurian System, pt. ii., 1839, p. 627, pl. xxvi., figs. 5-8.

2 Pal. New York, vol. ii., 1851, p. 98, pl. xxviii., figs. 12*a-e*.

3 Quart. Journ. Geol. Soc., vol. xxxviii., 1882, p. 379, pl. xv., figs. 1, 9, 10.

4 Description of Tasmanian Silurian Fossils presented to the Australian Museum. Hobart. 1896, p. 37, pl. —, figs. 10, 11.

5 Geol. Mag., 1900, p. 149, pl. vii., figs. 1-4. See also Whidborne and Blake, ibid., pp. 239, 240.

Prof. Blake has suggested (loc. cit. p. 240), "may very well be the remains of the intestine filled with matrix." This fossil form is now before me, two fine examples having been given to me on my departure for Australia in 1902, by Mr. Howard Fox, F.G.S., who discovered them, and who then wrote (Dec. 22nd, 1901): "I enclose a specimen of a fossil I have found abundantly at Bedruthan Steps, North Cornwall, and of which Upfield Green the year previous found two specimens on the south coast. *Pteroconus mirus*, Hinde (syn. *Nereitopsis*, Green). If you find any like it at Melbourne send me word. It seems to be a new form. Whidborne calls it *Cornulites*."

My object in writing this note is to draw attention to the corroborative evidence afforded by this related genus that *Cornulites* and *Pteroconus* (or *Nereitopsis*) are tubicolous annelids.[1] In my specimen of *Pteroconus* the basal extremity in each case is expanded, and shows signs of attachment in the larger specimen. *Pteroconus* has not yet been found in the Australian paleozoic sediments.

EXPLANATION OF PLATES.

Plate XIII.

Fig. 1.—*Trachyderma* sp. Part of a prostomial appendage near its termination, showing characteristic sigmoidal curvature of the axis. Silurian. N.W. of Keilor. A. James coll.

Fig. 2.—*Trachyderma* sp. Middle portion of a prostomial appendage, showing plumose character of gills, the striated axis, and vestiges of eye-spots and dorsal appendices. Silurian. N.W. of Keilor. A. James coll.

Fig. 3.—*Trachyderma crassituba*, Chap. A branch near the base of the prostomial appendage. Silurian (Melbournian). Hawthorn Main Drain. F. P. Spry coll.

Fig. 4.—*Cornulites youngi*, sp. nov. Median area of shell, showing ornament of annuli and interspaces. An enlargement of Fig. 13. Lower Ordovician. Moorabool River, near Meredith, N.W. of Geelong. J. H. Young coll.

All the above figures are enlarged 8 diameters.

Plate XIV.

Fig. 5.—*Trachyderma* sp. A narrow tube, widening rapidly to the aperture. It shows some characters pertaining to *T.*

1 Dr. Hinde regarded *Pteroconus* as a Pteropod; the Rev. G. F. Whidborne, as a Cephalopod (Orthoceracone); and Prof J. F. Blake, as a soft-bodied Polychaete.

crassituba, but is not sufficiently well preserved for exact identification. The matrix filling the orifice is stained with an ochreous deposit. To the right there is a fragment of a gill-plume which is like those seen in Fig. 12. Silurian. Probably on Warrandyte anticline, near Scotchman's Creek, Mulgrave. R. A. Keble coll.

Fig. 6.—*Trachyderma* sp. A large sigmoidal appendage, resembling in shape a note of interrogation. Silurian. N.W. of Keilor. A. James coll.

Fig. 7.—*Trachyderma* sp. A number of prostomial appendages on a slab of Silurian mudstone. The arrow points to a sharply bent fragment, from which the sketch showing eye-spots and appendices was obtained (Plate I., fig. 2.) N.W. of Keilor. A. James coll.

Fig. 8.—*Trachyderma crassituba*, Chapman. Some finely pectinated gill-plumes on dense, blue Silurian (Melbournian) mudstone, associated with tubes of this species. South Yarra Sewerage Works. F. P. Spry coll. 19/3/1897.

Fig. 9.—*T. crassituba*. A small sigmoidal appendage. In sandy, ochreous mudstone of a false-bedded character, probably denoting shore conditions. Silurian (Melbournian.) Domain Road Sewer. F. P. Spry coll.

Fig. 10.—*Trachyderma* sp. A curved fragment of a well preserved appendage. Silurian. N.W. of Keilor. A. James coll.

Fig. 11.—*Trachyderma* sp. A well preserved terminal fragment from which Fig. 1 on plate I. was sketched. Silurian. N.W. of Keilor. A. James coll.

Fig. 12.—*Trachyderma crassituba*, Chapm. Two appendages back to back, pointing to their probable paired habit in the living state. Fig. 3 of Plate I. was taken near the base of this specimen. Silurian (Melbournian.) Hawthorn Main Drain, Melbourne. F. P. Spry coll. 1903.

Fig. 13.—*Cornulites youngi*, sp. nov. Shell embedded in Lower Ordovician slate. Moorabool River, near Meredith, N.W. of Geelong. J. H. Young coll.

Fig. 14.—*C. youngi*, sp. nov. A senile example, much crushed. Lower Ordovician. Moorabool River, near Meredith, N.W. of Geelong. J. H. Young coll.

All figures on this plate slightly over natural size.